

Rodeo Grounds June Lake, California

Drainage Study

Project 996.2

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**Drainage Report****Rodeo Grounds
June Lake, California**

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***Drainage Study
Rodeo Grounds
June Lake, California***

1 - Introduction

Intrawest Corporation is proposing to develop the 90-acre Rodeo Grounds site across from the June Mountain parking lot at the intersection of Highway 158 and North Shore Boulevard. The improvements within the resort area will include hotels, condominiums and some commercial uses. Improvements on the remainder of the site are anticipated to include homes, duplexes and townhouses.

2 - Objective

This Drainage Plan is intended to describe the proposed drainage solutions for this site, give general assumptions, produce hydrologic results for existing and proposed conditions, and determine preliminary sizing for detention/retention facilities.

3 - Assumptions

Typically Precipitation Frequency Estimates are based upon the NOAA Atlas 14 results from the website, http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html. In this case, the area was outside the NOAA study area. We looked for IDF curves in the general vicinity. Each of these areas was outside of the influence of the Mountain range, and therefore had lower IDF values than we expect to see in June Lake. We decided it would be much more accurate to use an available curve with influence of the Mountain range. Since Mammoth Lakes has a well developed Storm Drainage Design Manual (excerpts in appendix D) and methodology, this was chosen. Historically, June Lake has received less precipitation than the Mammoth Lakes area; therefore this approach will be conservative.

A summary of the hydrologic calculations for peak runoff during a 20 year storm are included in Appendix B. The complete calculations can be provided upon request.

Pipe sizes for the final facilities will be sized based upon Mono County requirements at the time of the improvements.

The retention / detention area calculations were based upon a typical synthetic storm for the area adjusted to the area's runoff rate for a 20 year storm and a 1 hour total duration storm. These calculations are included in Appendix C.

4 - Observations

The June Lake Rodeo Grounds project is located in the eastern High Sierra at an elevation of between 7,500 – 7,800 feet (Average elevation 7,650 ft). Situated on approximately 87 acres, it is north of Highway 158 with the June Lake Loop on the south, and bisected by North Shore Drive that runs north south and intersects into Highway 158 (see Exhibit A: Vicinity Map). To the south of the property across the highway lie the parking lots and base facilities for June Mountain Ski Area operated by Mammoth Mountain Ski Area under permit from the USFS. Primarily, the lands bordering the site are public and under the jurisdiction of the USFS. The California State Lands Commission controls the water areas of Gull Lake. There is a 3.6-acre in holding parcel on the western edge of the site that is owned by Southern California Edison (SCE). A 15-acre undeveloped private parcel (Ronzi APN P5-010-16) is within 500' of the northeast corner of the Specific Plan Area.

The site is characterized by moderately sloping terrain comprised of a series of low ridges with numerous rock outcroppings. The majority of the slopes tend to be southeast-southwestern facing other than areas on the backside of ridgelines. Primary vegetation types on the site include plant communities associated with Big Sagebrush Scrub, Jeffery Pine Forest, Curl-leaf Mountain Mahogany Woodland, Aspen Woodland, and Kentucky Bluegrass meadow. Portions of the site on the ridgeline that conforms to the eastern property boundary have views into the Gull Lake Basin. An access road to the lake, boat launch and picnic area operated by the USFS is reached through this eastern portion of the property. The site is undeveloped except for a series of SCE aerial lines that run southwest to northeast across the site on both sides of North Shore Drive and a single residential structure located just east of North Shore Drive near the highway. There are several unpaved roads traversing the site, which provide access to and along the power line easements.

5 – Storm Drainage Systems

Refer to the Predevelopment Drainage Map, Post Development Drainage Map and the Quad map included in Appendix A – Figures. This shows the drainage areas and the proposed location of drainage retention/detention facilities.

The predevelopment drainage map (Exhibit 3) shows drainage areas and Q's for a 20 year storm at the limits of the property. The Quad map (Exhibit 2) shows those areas that are too far offsite to be shown by the drainage maps. The post development map (Exhibit 4) shows drainage Q's for a 20 year storm at the limits of the property, in the same locations as Exhibit 3, but the numbers shown are for the post development conditions. Additionally, the location of predicted retention/detention facilities are shown, as well as the planned 'after detention' runoff rates.

Area A – Runoff from improvements in this area will be directed toward a detention facility. This detention facility will be located either in area A or combined with area Y as determined by final design. The unimproved area will continue to flow at historic rates and historic locations. No detention will be provided for unimproved area.

Area B, C, D, E, and F – The runoff from each area exits the site in a generally sheet flow condition toward Gull Lake. In these areas we propose to provide runoff control in the form of natural ditches and swales set up as level spreaders to reduce runoff to its predevelopment level, while maintaining a sheet flow condition. This will allow runoff to exit the site in a pattern similar to historic conditions.

Area G - Runoff from improvements in this area will be directed toward a detention / retention facility. The location of this facility and retention requirements will be determined during final design. The unimproved area will continue to flow at historic rates and historic locations. No detention will be provided for unimproved area.

Area H – This area will also be modified by Area X, but there will still be improvements in the area. The runoff from this area is directed toward North Shore Drive. This area is of particular concern due to the concentration of runoff due to North Shore Drive. Therefore,

this area will include retention of the full 20 year one-hour storm. This area will be designed to drain into the Area X system and runoff will be retained in the area X retention system. Approximate retention facility sizing calculations for area H are included in Appendix C.

Area J and K – These areas have significant improvements. The runoff from these areas exits the site at Boulder drive. There is a ridge that separates these areas. In these areas we propose to provide runoff control in the form of natural ditches and swales set up as level spreaders to reduce runoff to its predevelopment level, while maintaining a sheet flow condition. This will allow runoff to exit the site in a pattern similar to historic conditions.

Area L, N, O, and P – Runoff from improvements in these areas will be directed toward a retention facility located in Area X. The unimproved area will continue to flow at historic rates and historic locations. No detention will be provided for unimproved area.

Area M – A portion of this area will be modified by area X and directed toward that retention facility. The runoff from the other improvements in this area will be directed toward a detention system adjacent to Highway 158.

Area X and Y – Area X includes portions of areas L, M, N, O, and P. Area Y includes portions of areas A and B. These areas will be designed specifically to isolate the improved areas from unimproved areas within the development. A significant portion of the new runoff will be contained in large retention/detention facilities. Runoff for area X will be contained at the corner of North Shore Drive and Boulder Drive. Area Y runoff may be contained in this facility or another facility placed in the parking lot of the Employee Housing. The retention facility or facilities will be designed to retain the 20 year storm, as opposed to the other areas that will be designed to detain the 20 year storm. In storms of larger intensity, the runoff will backup in the storm drainage system, and generally overflow toward historic directions. Approximate retention facility sizing calculations for area X and area Y are included in Appendix C.

6 - Conclusions

The historic condition of this site includes runoff exiting the site in all directions (north, east, west and south) in generally sheet flow conditions, without distinct swales or ditches. The design proposed in this report will allow the site to continue to maintain this type of runoff after development.

These improvements will be constructed in phases. Portions of the large retention facility proposed for Area X and Y will need to be built as required for development that occurs within Areas X and Y. The smaller retention / detention facilities in the other areas must be built when improvements are made in their respective tributary areas.

Runoff Q's have been calculated for general areas. The included summary of calculations indicates the runoff Q for a 20 year storm. Design of facilities will be based on storms of an exceedence level as required by the County. These Q's as well as Q's for isolated areas will be used for the design of the storm drainage inlets, pipes, curb flow conditions and site drainage. Final designs of each of these facilities will be made during the final design of the respective improvements. The standards and requirements in place at the time of these improvements will be followed.

For areas that are developed as lots, the detention provided as part of the Intrawest Improvements will be for just the improvements constructed. Requirements must be developed to provide for retention for the additional impervious area created by construction of homes, driveways and other lot improvements.

The designs and calculations included in this document are for planning purposes. Facility design will be finalized during final design in accordance with County requirements in place at the time.

Storm drainage facilities require maintenance. While these facilities will be designed to be low maintenance the facilities must be inspected annually, after significant storms and as requested or required by governing agencies. If facilities are found to need maintenance this shall be performed at the earliest time practicable.



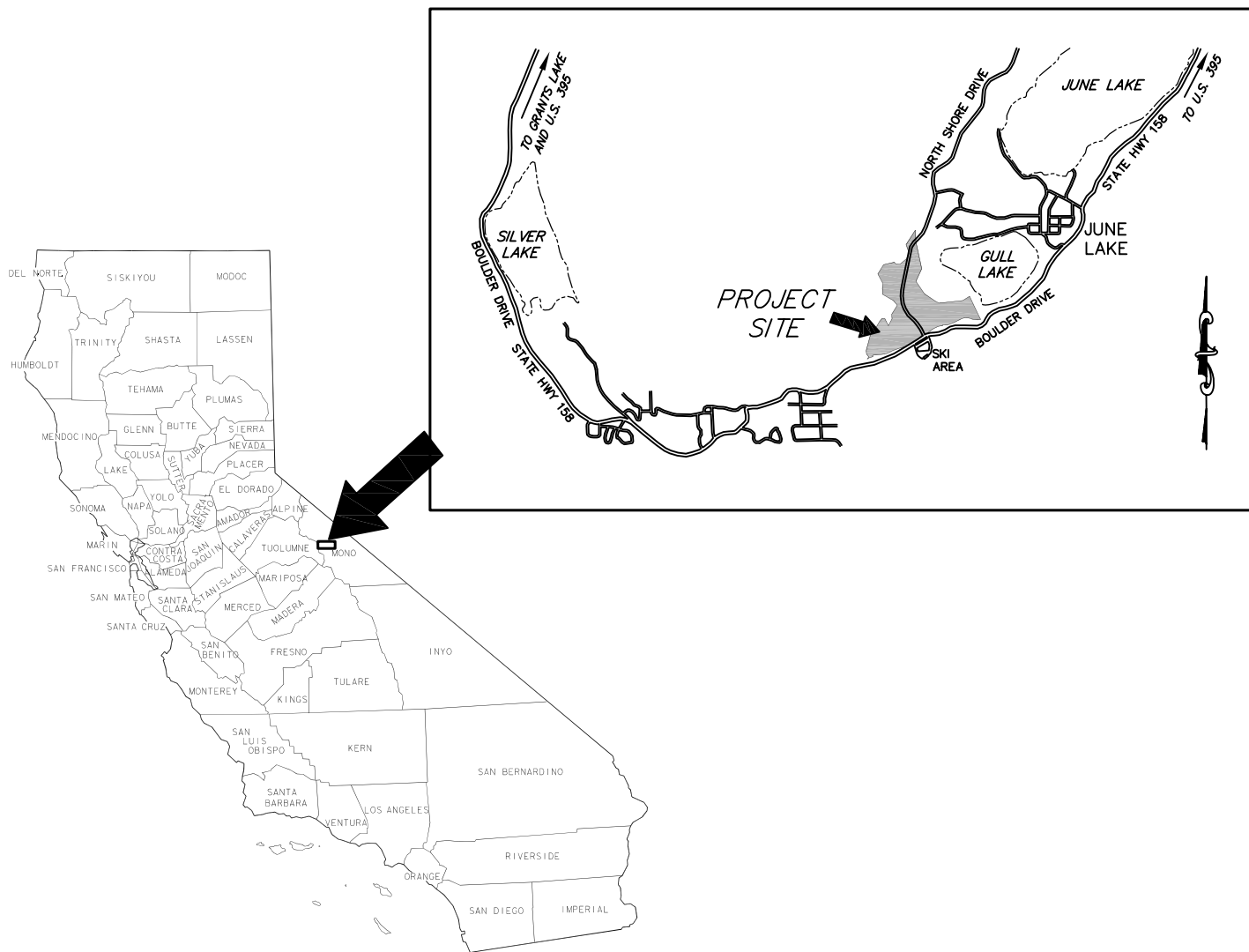
All facilities shall be designed to eliminate erosion and contaminated runoff to the greatest extent practicable. All construction must be done in full conformance with the Clean Water Act, the State and Regional Water Quality Control Boards, and Mono County requirements.



Rodeo Grounds, June Lake, California

Appendix A

Figures



VICINITY MAP

NOT TO SCALE

Exhibit 1



Rodeo Grounds, June Lake, California

Appendix B

Hydrology Calculations

RODEO

Hydrology Calculations - Summary

Area	Design Q	Exceedance Interval	Winter Q at Exceedance Interval	Winter Intensity	Winter Average Cfactor	Summer Q at Exceedance Interval	Summer Intensity	Summer Average Cfactor	Acres	Calc Page	Comments
<i>A - pre-development</i>	<i>8.7</i>	<i>Q20</i>	<i>8.7</i>	<i>0.9</i>	<i>0.5</i>	<i>5.2</i>	<i>1.1</i>	<i>0.2</i>	<i>21.00</i>	<i>3</i>	<i>includes offsite runoff</i>
A - post-development	8.3	Q20	8.3	0.9	0.5	5.0	1.1	0.2	20.21	5	Improvement portions of this area diverted toward new area Y, Runoff Quantity and Rate are reduced
<i>B - pre-development</i>	<i>6.5</i>	<i>Q20</i>	<i>6.5</i>	<i>0.9</i>	<i>0.5</i>	<i>4.0</i>	<i>1.1</i>	<i>0.2</i>	<i>15.53</i>	<i>7</i>	<i>includes offsite runoff</i>
B - Post Development	7.7	Q20	7.7	0.9	0.6	6.3	1.1	0.4	15.53	9	includes offsite runoff, Detention used to limit flow to predevelopment conditions
<i>C - pre-development</i>	<i>14.5</i>	<i>Q20</i>	<i>14.5</i>	<i>0.9</i>	<i>0.5</i>	<i>9.2</i>	<i>1.1</i>	<i>0.2</i>	<i>34.27</i>	<i>11</i>	<i>includes offsite runoff</i>
C - Post Development	17.7	Q20	17.7	0.9	0.6	15.5	1.1	0.4	34.27	13	includes offsite runoff, Detention used to limit flow to predevelopment conditions
<i>D - pre-development</i>	<i>0.6</i>	<i>Q20</i>	<i>0.6</i>	<i>1.0</i>	<i>0.5</i>	<i>0.5</i>	<i>1.4</i>	<i>0.2</i>	<i>1.43</i>	<i>15</i>	<i>Detention used to limit flow to predevelopment conditions</i>
D - Post Development	0.8	Q20	0.8	1.0	0.6	0.7	1.4	0.4	1.43	17	Detention used to limit flow to predevelopment conditions
<i>E - pre-development</i>	<i>0.4</i>	<i>Q20</i>	<i>0.4</i>	<i>0.9</i>	<i>0.5</i>	<i>0.2</i>	<i>1.3</i>	<i>0.2</i>	<i>0.83</i>	<i>19</i>	<i>Detention used to limit flow to predevelopment conditions</i>
E - Post Development	0.4	Q20	0.4	0.9	0.6	0.4	1.3	0.4	0.83	21	Detention used to limit flow to predevelopment conditions
<i>F - pre-development</i>	<i>0.6</i>	<i>Q20</i>	<i>0.6</i>	<i>0.9</i>	<i>0.5</i>	<i>0.4</i>	<i>1.3</i>	<i>0.2</i>	<i>1.48</i>	<i>23</i>	<i>Detention used to limit flow to predevelopment conditions</i>
F - Post Development	0.8	Q20	0.8	0.9	0.6	0.7	1.3	0.4	1.48	25	Detention used to limit flow to predevelopment conditions
<i>G - pre-development</i>	<i>3.3</i>	<i>Q20</i>	<i>3.3</i>	<i>0.9</i>	<i>0.5</i>	<i>2.2</i>	<i>1.3</i>	<i>0.2</i>	<i>7.60</i>	<i>27</i>	<i>Improvement portions of this area diverted toward new area Y, Runoff Quantity and Rate are reduced</i>
G - post-development	2.3	Q20	2.3	0.9	0.5	1.5	1.3	0.2	5.40	29	Improvement portions of this area diverted toward new area Y, Runoff Quantity and Rate are reduced
<i>H - pre-development</i>	<i>8.8</i>	<i>Q20</i>	<i>8.8</i>	<i>0.8</i>	<i>0.5</i>	<i>5.2</i>	<i>0.9</i>	<i>0.3</i>	<i>21.80</i>	<i>31</i>	<i>Detention provided to limit flow to predevelopment conditions, This may be located in area H or X</i>
H - Post Development	9.6	Q20	9.6	0.8	0.6	7.4	0.9	0.4	20.00	33	Detention provided to limit flow to predevelopment conditions, This may be located in area H or X
<i>J - pre-development</i>	<i>3.8</i>	<i>Q20</i>	<i>3.8</i>	<i>0.9</i>	<i>0.4</i>	<i>2.3</i>	<i>1.1</i>	<i>0.2</i>	<i>9.65</i>	<i>35</i>	<i>Detention used to limit flow to predevelopment conditions</i>
J - Post Development	5.4	Q20	5.4	0.9	0.6	5.3	1.1	0.5	9.65	37	Detention used to limit flow to predevelopment conditions

RODEO

Hydrology Calculations - Summary

Area	Design Q	Exceedance Interval	Winter Q at Exceedance Interval	Winter Intensity	Winter Average Cfactor	Summer Q at Exceedance Interval	Summer Intensity	Summer Average Cfactor	Acres	Calc Page	Comments
<i>K - pre-development</i>	3.7	Q20	3.7	0.9	0.5	2.4	1.3	0.2	8.63	39	<i>Includes offsite runoff.</i>
K - Post Development	4.3	Q20	4.3	0.9	0.5	3.7	1.3	0.3	8.63	41	Includes offsite runoff. Detention used to limit flow to predevelopment conditions
<i>L - pre-development</i>	1.8	Q20	1.8	1.0	0.5	1.3	1.4	0.2	4.20	43	
L - post-development	0.5	Q20	0.5	1.0	0.5	0.4	1.4	0.2	1.17	45	Improvement portion of this area diverted toward new area X, Runoff Quantity and Rate are reduced
<i>M - pre-development</i>	2.6	Q20	2.6	0.9	0.5	1.8	1.4	0.2	5.90	47	
M - Post Development	0.9	Q20	0.9	0.9	0.5	0.8	1.4	0.3	1.73	49	Improvement portion of this area diverted toward new area X, Runoff Quantity and Rate are reduced. Runoff from Parking lot will also be retained.
<i>N - pre-development</i>	1.5	Q20	1.5	0.9	0.4	0.9	1.2	0.2	3.70	51	
N - post-development	0.9	Q20	0.9	0.9	0.4	0.6	1.2	0.2	2.25	53	Improvement portion of this area diverted toward new area X, Runoff Quantity and Rate are reduced
<i>O - pre-development</i>	2.5	Q20	2.5	0.9	0.5	1.5	1.2	0.2	5.90	55	
O - post-development	2.2	Q20	2.2	0.9	0.5	1.4	1.2	0.2	5.32	57	Improvement portion of this area diverted toward new area X, Runoff Quantity and Rate are reduced
<i>P - pre-development</i>	2.3	Q20	2.3	1.0	0.5	1.7	1.5	0.2	5.10	59	
P - post-development	1.0	Q20	1.0	1.0	0.5	0.8	1.5	0.2	2.24	61	Improvement portion of this area diverted toward new area X, Runoff Quantity and Rate are reduced
<i>X - Predevelopment</i>		Q20									<i>Part of Areas H, L, M, N, O and P</i>
X - Post Development	23.6	Q20	20.2	1.9	0.7	23.6	2.5	0.7	14.20	63	Improvement Areas from A and C, runoff contained in Retention Facilities
<i>Y - Predevelopment</i>		Q20									<i>Part of Areas A and C</i>
Y - Post Development	5.0	Q20	4.3	1.9	0.7	5.0	2.5	0.7	3.00	65	Improvement Areas from A and C, runoff contained in Retention Facilities



Rodeo Grounds, June Lake, California

Appendix C

Detention/Retention Calculations

RODEO GROUNDS AREA X

Site	X
Area	14.2
Exceedence Interval Tc	20 Year 0.1 hours
Proposed Condition Inflow Rate	23.60 cfs
Outflow Rate	0.00 cfs
Basin Size	22700 CUBIC FEET

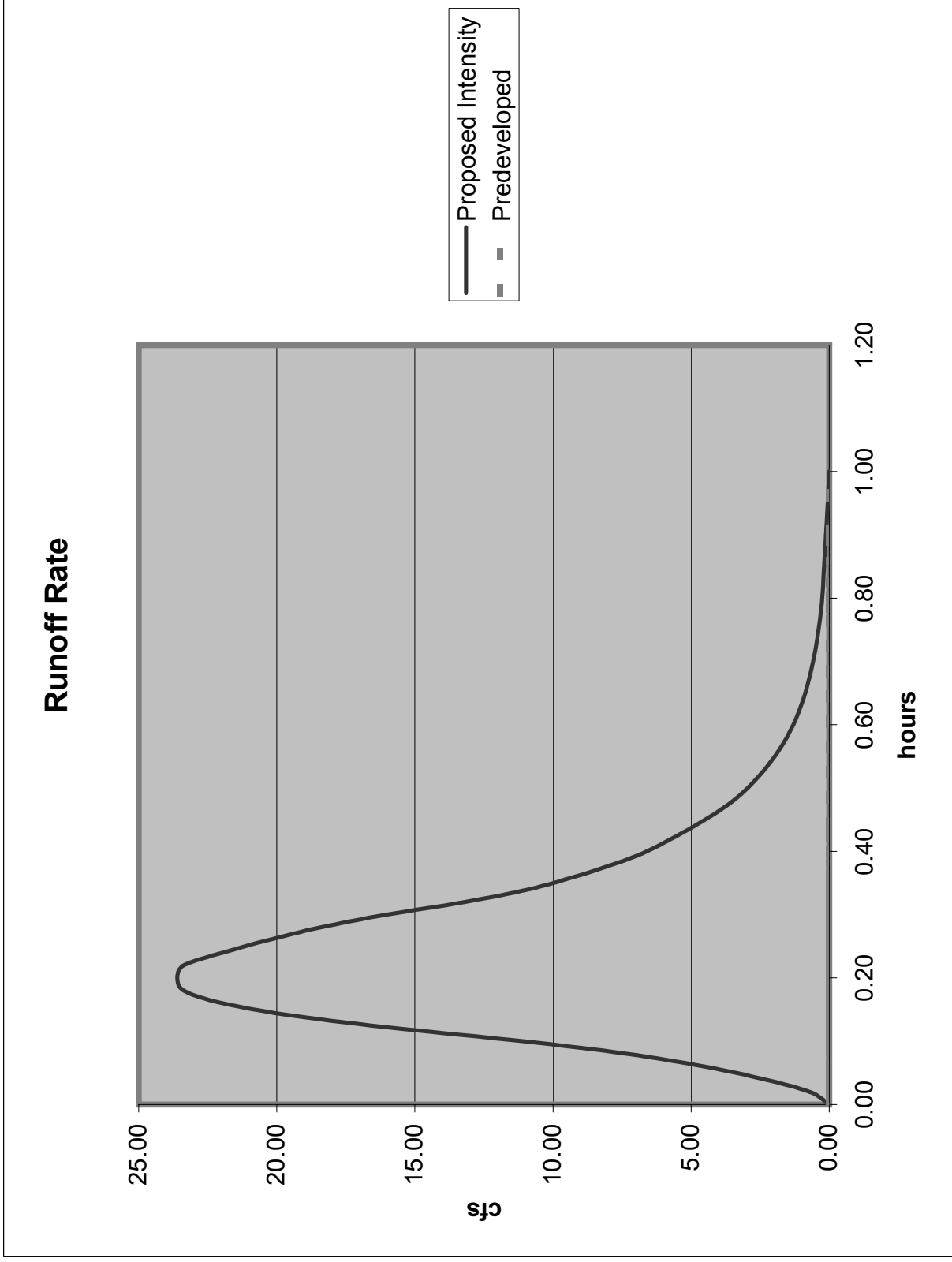
Proposed Conditions		
Q=1.008CIA	(rational)	23.60 cfs

Existing Conditions (outflow for area H)		
Q=1.008CIA	(rational)	8.80 cfs

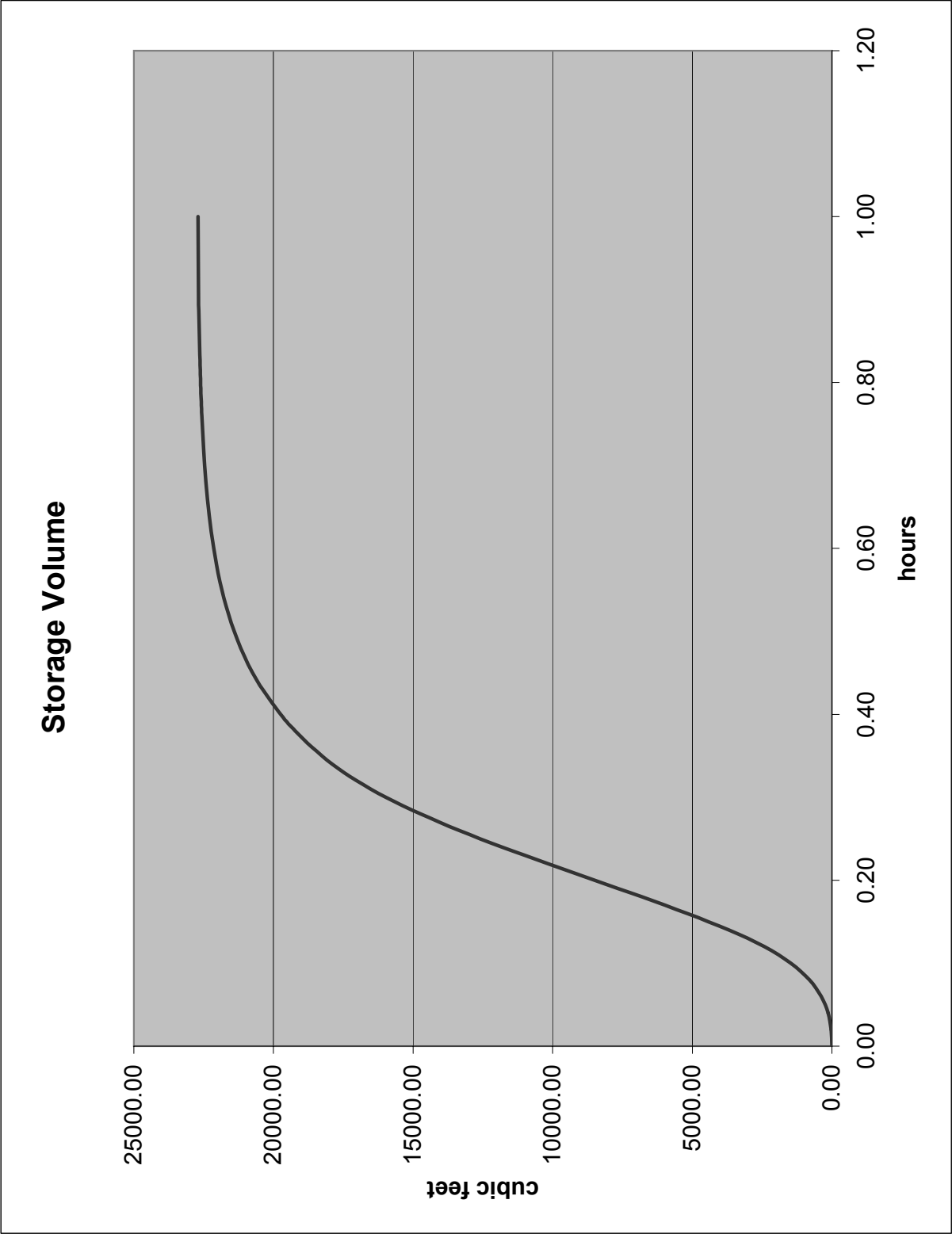
RODEO GROUNDS AREA X

Storm duration			20 year		1 hour	
MAXIMUM VOLUME REQUIRED=					22700 CUBIC FEET	
<i>tp=</i>	<i>0.200</i>	<i>Qp=</i>	<i>23.60</i>		<i>predeveloped rate</i>	<i>0.00</i>
ti/tp	ti (hours)	Qi/Qp	Qi (cfs)	ti*Qi Volume cf	peak predeveloped runoff cf	accumulated volume
0	0.00	0	0.00			
0.1	0.02	0.03	0.71	25.49	0.00	25.49
0.2	0.04	0.1	2.36	110.45	0.00	135.94
0.3	0.06	0.19	4.48	246.38	0.00	382.32
0.4	0.08	0.31	7.32	424.80	0.00	807.12
0.5	0.10	0.47	11.09	662.69	0.00	1469.81
0.6	0.12	0.66	15.58	960.05	0.00	2429.86
0.7	0.14	0.82	19.35	1257.41	0.00	3687.26
0.8	0.16	0.93	21.95	1486.80	0.00	5174.06
0.9	0.18	0.99	23.36	1631.23	0.00	6805.30
1	0.20	1	23.60	1690.70	0.00	8496.00
1.1	0.22	0.99	23.36	1690.70	0.00	10186.70
1.2	0.24	0.93	21.95	1631.23	0.00	11817.94
1.3	0.26	0.86	20.30	1520.78	0.00	13338.72
1.4	0.28	0.78	18.41	1393.34	0.00	14732.06
1.5	0.30	0.68	16.05	1240.42	0.00	15972.48
1.6	0.32	0.56	13.22	1053.50	0.00	17025.98
1.7	0.34	0.46	10.86	866.59	0.00	17892.58
1.8	0.36	0.39	9.20	722.16	0.00	18614.74
1.9	0.38	0.33	7.79	611.71	0.00	19226.45
2	0.40	0.28	6.61	518.26	0.00	19744.70
2.2	0.44	0.207	4.89	827.51	0.00	20572.21
2.4	0.48	0.147	3.47	601.52	0.00	21173.73
2.6	0.52	0.107	2.53	431.60	0.00	21605.33
2.8	0.56	0.077	1.82	312.65	0.00	21917.98
3	0.60	0.055	1.30	224.29	0.00	22142.28
3.2	0.64	0.04	0.94	161.42	0.00	22303.70
3.4	0.68	0.029	0.68	117.24	0.00	22420.94
3.6	0.72	0.021	0.50	84.96	0.00	22505.90
3.8	0.76	0.015	0.35	61.17	0.00	22567.08
4	0.80	0.011	0.26	44.18	0.00	22611.25
4.5	0.90	0.005	0.12	67.97	0.00	22679.22
5	1.00	0	0.00	21.24	0.00	22700.46

RODEO GROUNDS AREA X



RODEO GROUNDS AREA X



RODEO GROUNDS AREA Y

Site	Y
Area	3
Exceedence Interval Tc	20 Year 0.1 hours
Proposed Condition Inflow Rate	5.00 cfs
Outflow Rate	0.00 cfs
Basin Size	4809 CUBIC FEET

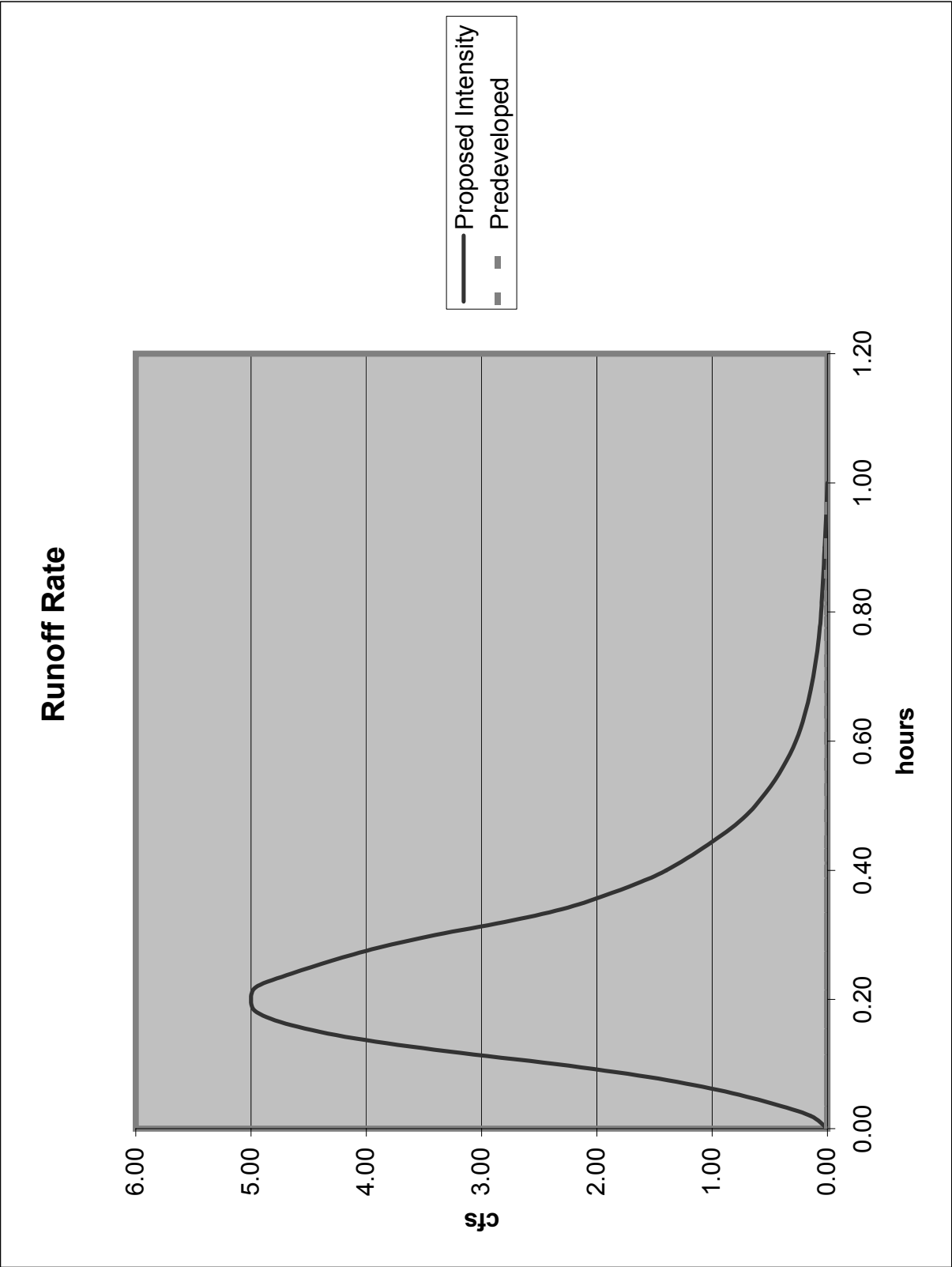
Proposed Conditions		
Q=1.008CIA	(rational)	5.00 cfs

Existing Conditions (runoff to area G)		
Difference between predevelopment Q20 of 3.3 cfs and post development Q20 of 2.3 cfs		
Q=1.008CIA	(rational)	1.00 cfs

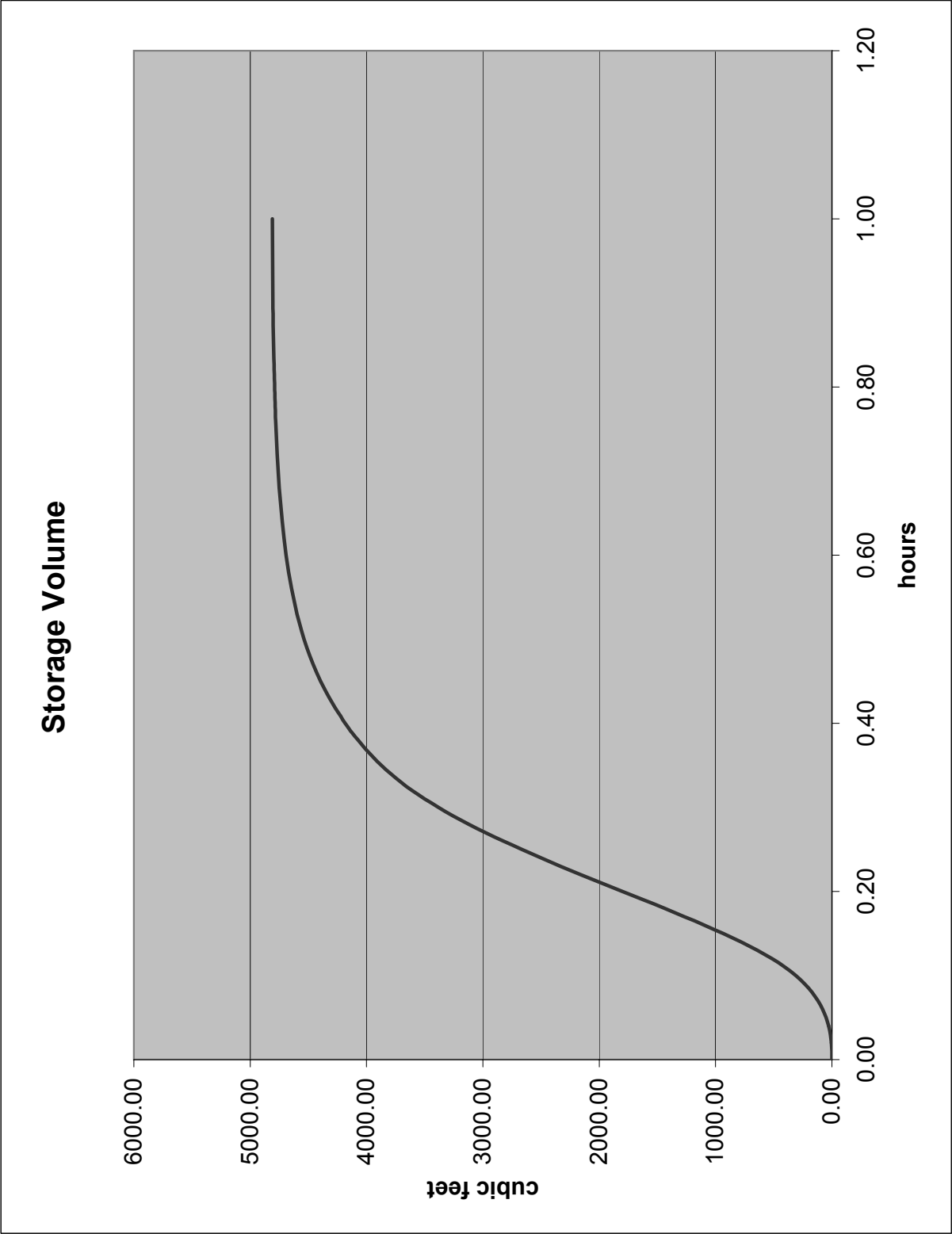
RODEO GROUNDS AREA Y

Storm duration			20 year		1 hour	
MAXIMUM VOLUME REQUIRED=					4809 CUBIC FEET	
<i>tp=</i>	<i>0.200</i>	<i>Qp=</i>	<i>5.00</i>		<i>predeveloped rate</i>	<i>0.00</i>
ti/tp	ti (hours)	Qi/Qp	Qi (cfs)	ti*Qi Volume cf	peak predeveloped runoff cf	accumulated volume
0	0.00	0	0.00			
0.1	0.02	0.03	0.15	5.40	0.00	5.40
0.2	0.04	0.1	0.50	23.40	0.00	28.80
0.3	0.06	0.19	0.95	52.20	0.00	81.00
0.4	0.08	0.31	1.55	90.00	0.00	171.00
0.5	0.10	0.47	2.35	140.40	0.00	311.40
0.6	0.12	0.66	3.30	203.40	0.00	514.80
0.7	0.14	0.82	4.10	266.40	0.00	781.20
0.8	0.16	0.93	4.65	315.00	0.00	1096.20
0.9	0.18	0.99	4.95	345.60	0.00	1441.80
1	0.20	1	5.00	358.20	0.00	1800.00
1.1	0.22	0.99	4.95	358.20	0.00	2158.20
1.2	0.24	0.93	4.65	345.60	0.00	2503.80
1.3	0.26	0.86	4.30	322.20	0.00	2826.00
1.4	0.28	0.78	3.90	295.20	0.00	3121.20
1.5	0.30	0.68	3.40	262.80	0.00	3384.00
1.6	0.32	0.56	2.80	223.20	0.00	3607.20
1.7	0.34	0.46	2.30	183.60	0.00	3790.80
1.8	0.36	0.39	1.95	153.00	0.00	3943.80
1.9	0.38	0.33	1.65	129.60	0.00	4073.40
2	0.40	0.28	1.40	109.80	0.00	4183.20
2.2	0.44	0.207	1.04	175.32	0.00	4358.52
2.4	0.48	0.147	0.74	127.44	0.00	4485.96
2.6	0.52	0.107	0.54	91.44	0.00	4577.40
2.8	0.56	0.077	0.39	66.24	0.00	4643.64
3	0.60	0.055	0.28	47.52	0.00	4691.16
3.2	0.64	0.04	0.20	34.20	0.00	4725.36
3.4	0.68	0.029	0.15	24.84	0.00	4750.20
3.6	0.72	0.021	0.11	18.00	0.00	4768.20
3.8	0.76	0.015	0.08	12.96	0.00	4781.16
4	0.80	0.011	0.06	9.36	0.00	4790.52
4.5	0.90	0.005	0.03	14.40	0.00	4804.92
5	1.00	0	0.00	4.50	0.00	4809.42

RODEO GROUNDS AREA Y



RODEO GROUNDS AREA Y





Rodeo Grounds, June Lake, California

Appendix D

**Design Manual – Mammoth Lakes Storm Drainage and Erosion Control
Prepared for Mono County Public Works Department, July 1984
Brown and Caldwell and Triad Engineering (excerpts)**